

Calorimetry: Physical Processes HW #1 to 7 (handout)

Solutions:

$$\#1) \Delta H = 400 \text{ g} \times \frac{1 \text{ mol}}{18.01 \text{ g}} \times \frac{6.01 \text{ kJ}}{1 \text{ mol}} = 13.3 \text{ kJ}$$

$$\#2) \Delta H = 50.0 \text{ g} \times \frac{1 \text{ mol}}{18.01 \text{ g}} \times \frac{40.7 \text{ kJ}}{1 \text{ mol}} = 113 \text{ kJ}$$

#3) ① steam at 100°C to liquid at $100^\circ\text{C} \Rightarrow \text{need at least} = -40.7 \text{ kJ/mol}$
 + ② liquid at 100°C to liquid at $35^\circ\text{C} \Rightarrow Q = mc\Delta T$

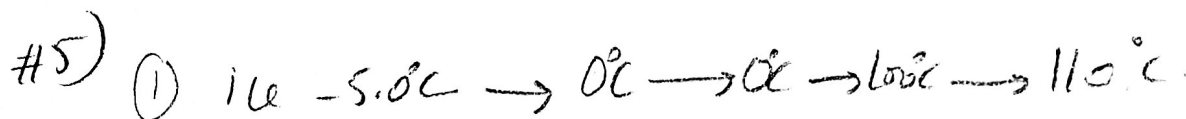
$$\begin{aligned} \Delta H &= 500 \text{ g} \times \frac{1 \text{ mol}}{18.01 \text{ g}} \times \frac{-40.7 \text{ kJ}}{1 \text{ mol}} + 500 \text{ g} \times 4.18 \text{ J/g}^\circ\text{C} \times (35 - 100) \\ &= -1129.9 \text{ kJ} + (-135850) \text{ J} \\ &= -1129.9 \text{ kJ} - 135.850 \text{ kJ} \\ &= -1265.75 \text{ kJ} \\ &= -1266 \text{ kJ} \end{aligned}$$

#4) ① ice -10°C to 0°C ② H_2O 0°C to 20°C
 ③ water 0°C to 0°C

$$\Delta H = \boxed{\text{① } 0.20 \text{ kg ice} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{2.11 \text{ J}}{\text{g}^\circ\text{C}} \times (0 - (-10))} + \boxed{\text{② } 200 \text{ g} \times \frac{1 \text{ mol}}{18.01 \text{ g}} \times \frac{6.01 \text{ kJ}}{1 \text{ mol}}}$$

$$= 4220 \text{ J or } 4.22 \text{ kJ} + 66.7 \text{ kJ}$$

$$\begin{aligned} + \text{③ } &\boxed{+ 200 \text{ g} \times \frac{4.18 \text{ J}}{\text{g}^\circ\text{C}} \times (20 - 0^\circ\text{C})} \\ &+ 16.72 \text{ kJ} \end{aligned} \quad \begin{aligned} &= 4.22 + 66.7 + 16.7 \\ &= 88 \text{ kJ} \end{aligned}$$



$$m = 0.100 \text{ kg} \times 1000 \text{ g/kg}$$

$$m = 100 \text{ g}$$

$$n = \frac{100 \text{ g}}{18.01} = 5.55 \text{ mol}$$

$$\Delta H = m_{ice} c_{ice} (5^{\circ}C) + n \times \Delta H_{\text{melt}} + m_{H_2O} c_{H_2O} (100^{\circ}C) + n \times \Delta H_{\text{vap}} + m_{\text{steam}} c_{\text{steam}} (10^{\circ}C)$$

$$= 100 \text{ g} \times \frac{2.01 \text{ J}}{\text{g}^{\circ}C} \times 5^{\circ}C + 5.55 \text{ mol} \times \frac{6.01 \text{ kJ}}{\text{mol}} + 100 \times 4.18 \times 100 + 5.55 \times 40.7 + 100 \times 2.0 \times 10$$

$$= 1005 \text{ J} + 33.4 \text{ kJ} + 41800 \text{ J} + 222.4 \text{ kJ} + 2000 \text{ J}$$

$$= 1.005 \text{ kJ} + 33.4 \text{ kJ} + 41.800 \text{ kJ} + 222.4 \text{ kJ} + 2.00 \text{ kJ}$$

$$= 301 \text{ kJ}$$

#6) Total Energy Change = 25.5 kJ

$$25.5 \text{ kJ} = \frac{n \times \Delta H_{\text{melt}}}{\text{melting}} + \frac{m c \Delta T}{\text{going from } 0^{\circ} \text{ to } 25^{\circ}}$$

$$25500 \text{ J} = \frac{m}{18.01 \text{ g/mol}} \times \frac{6.01 \text{ kJ}}{1 \text{ mol}} \times \frac{1000 \text{ J}}{\text{kJ}} + m \times 4.18 \times 25$$

$$25500 = 333.7 m + 104.5 m$$

$$25500 = 438.2 m$$

$$\frac{25500}{438.2} = m \quad \therefore m = 58.2 \text{ g}$$

#7) $Q = 40 \text{ g} \times 2.11 \text{ J/g}^{\circ}C \times (-15 - (-5))$

$$= 40 \times 2.01 \times (-10)$$

$$= -804 \text{ J}$$